IN THE SPECIFICATION:

Please replace paragraph number **[0042]** with the following rewritten paragraph:

[0042] The substrate assembly 100 further comprises a layer of resilient conductive material 130 formed on at least the upper surface 122 of the substrate 120 or a suitable portion thereof. ~~122.~~ The layer of resilient conductive material 130 comprises any suitable conductive material that also exhibits elastic properties suitable for the formation of spring-biased electrical contacts, as will be described in greater detail below. By way of example, the layer of resilient conductive material 130 may comprise a copper alloy material, such as beryllium copper. The layer of resilient conductive material 130 may be formed on the substrate 120 using any suitable process. For example, the layer of resilient conductive material 130 may be formed on the upper surface 122 of the substrate 120 using a sputtering process, a chemical vapor deposition (CVD) process, or any other suitable deposition process known in the art. Alternatively, the layer of resilient conductive material 130 may be a separately formed laminate that is subsequently secured to, or laminated on, the upper surface 122 of the substrate 120 using, for example, an adhesive and/or a thermocompression bonding process.

Please replace paragraph number **[0044]** with the following rewritten paragraph:

[0044] As noted above, at least some of the conductive traces 132 each terminate at a spring-biased electrical contact 160. Referring to FIGS. 3 through 6, each spring-biased electrical contact 160 comprises, for example, a cantilevered spring 162 formed in the layer of resilient conductive material 130 and configured to bias against and form electrical contact with a conductive ball 41 of the BGA package 10 or other lead element. The cantilevered spring 162 includes an upper surface 164 for making physical and electrical contact with the conductive ball 41 (shown in dashed line in FIG~~S~~. ~~3, 4, and~~ 6). An aperture 136 formed in the layer of resilient conductive ~~layer~~ material 130 around the cantilevered spring 162 separates and electrically isolates the cantilevered spring 162 from the remainder of the layer of resilient conductive material 130. The spring-biased electrical contacts 160 and surrounding apertures 136 may also be formed using a chemical etching or laser ablation process, and the

shapes of the spring-biased electrical contacts 160 and apertures 136 may also be cut or formed using a stamping process.

Please replace paragraph number **[0045]** with the following rewritten paragraph:

[0045] It should be noted that the layer of resilient conductive material 130 may be sandwiched between a lower dielectric layer of substrate 120 and an upper dielectric layer thereof which overlies layer of resilient conductive material 130, the upper dielectric layer defining upper surface ~~124.~~ 122. Referring to FIGS. 4 and 5 of the drawings, an exemplary overlying dielectric or insulative layer 121 having apertures 123 therein substantially aligned with apertures 136 may be disposed over the layer of resilient conductive material 130 after formation of the conductive traces 132 and spring-biased electrical contacts 160. The apertures in overlying dielectric layer 121 may be sized and configured to receive portions of conductive balls 41 of a BGA package (see FIG. 5 and description below) therein, and overlying dielectric layer 121 may be of sufficient thickness to assist with alignment of conductive balls 41 with spring-biased electrical contacts 160. If desired, apertures 123 may be of frustoconical shape as shown by aperture 123′ with a wider upper portion to assist in the initial alignment of conductive balls 41.

Please replace paragraph number **[0046]** with the following rewritten paragraph:

[0046] Referring to FIG. 4A, a cutting tool 160′ is illustrated that is used to form the spring-biased electrical contacts 160. The cutting tool 160′ comprises a generally cylindrical body or shaft portion 702 terminating in a substantially flat end 708 substantially located in a plane 710 which is located with respect to a vertical axis, such as 712, the body or shaft portion 702 having a helical cutting spiral 704 attached to and/or formed thereon. The helical cutting spiral 704 terminates in a cutting face 706 located at the bottom end of the spiral ~~706~~ 704 in substantially the same plane 710 as the end 708 of the body or shaft portion 702. The helical cutting spiral 704 may be formed at any suitable helical angle on the body or shaft portion 702 depending upon the amount of desired rotation of the cutting tool 160′ ~~is to be~~ to be used to form a spring-biased electrical contact 160. If desired, the end 708 of the cutting tool 160′ may

protrude beyond plane 710 in any suitable shape (illustrated in a dashed line 714) to be used as a pilot when engaged in ~~aperture~~ a via 126 (FIGS. 3 and 4) of substrate 120 for the forming of the spring-biased electrical contact 160. The cutting face 706 of the helical cutting spiral 704 may be any suitable shape capable of forming the desired shape of the spring-biased electrical contact 160. For example, the cutting face 706 may be concave shaped, convex shaped, a combination of concave and convex shaped, etc. To form the spring-biased electrical contact 160, the cutting tool 160′ is placed upon on the precursor structure of the spring-biased electrical contact 160, such as illustrated in FIG. 3 when the precursor structure of spring-biased electrical contact 160 is a layer on the substrate 120, and the cutting tool 160′ subsequently rotated a desired amount for cutting face 706 to cut through a portion or the entirety of the precursor structure (layer) to form a length of resilient material and cause a portion thereof to be bent upwardly along the helical cutting spiral 704. Thereafter, the cutting tool 160′ is rotated in the opposite direction to remove the cutting tool 160′ from the formed spring-biased electrical contact 160.

Please replace paragraph number **[0055]** with the following rewritten paragraph:

[0055] A spring-biased electrical contact 160 may comprise alternative shapes or configurations other than the cantilevered spring 162 shown and described with respect to FIGS. 3 through 9. For example, with reference to FIGS. 10 and 11, a spring-biased electrical contact 160 may comprise a transversely deflecting, hoop-shaped spring 262 formed in the layer of resilient conductive material 130. The hoop-shaped spring 262 comprises two semicircular arms 263a, 263b formed within an aperture 136 in the resilient conductive layer 130 and suspended over a via 126 formed in the substrate 120, the respective ends of the semicircular arms 263a, 263b being separated by a gap 264. The semicircular arms 263a, 263b are configured – upon engagement with a conductive ball 41 (shown in dashed line in FIGS. 10 and 11) of the BGA ~~component~~ package 10 - to transversely deflect in the plane of the layer of resilient conductive material 130 (as shown by arrows 265a, 265b). A notch 266 located intermediate of the semicircular arms 263a, 263b may facilitate deflection thereof, respectively. Further, the

hoop-shaped spring 262 may also deflect downwardly into the via 126 in a manner similar to the cantilevered spring 162.

Please replace paragraph number **[0058]** with the following rewritten paragraph:

[0058] In another embodiment of the present invention, a spring-biased electrical contact 160 comprises a spiral-shaped spring 362, as shown in FIGS. 12 and 13. The spiral-shaped spring 362 is formed in the layer of resilient conductive ~~layer~~ material 130 within an aperture 136, and the spiral-shaped spring 362 extends from a conductive trace 132 and over a via 126 formed in the substrate 120. The spiral-shaped spring 362 includes an upper surface 364 for making physical and electrical contact with a conductive ball 41 (shown in dashed line in FIGS. 12 and 13) of the BGA package 10. Upon engagement with a conductive ball 41 of the BGA package 10, at least a portion of the spiral-shaped spring 362 will deflect downwardly into the via 126, thereby exerting a biasing force against the conductive ball 41 and establishing physical and electrical contact therewith. Also, as shown in FIG. 13, during engagement with the conductive ball 41 and deflection downwardly into the via 126, the spiral-shaped spring 362 may be configured to form a cup or recess 366 for receiving the conductive ball 41 and aligning the conductive ball 41 relative to the spiral-shaped spring 362.

Please replace paragraph number **[0059]** with the following rewritten paragraph:

[0059] To facilitate the removal of oxides and contaminants from the exterior surface of the conductive ball 41, the spiral-shaped spring 362 may ~~includes~~ include a plurality of grooves 191 and ridges 192 (see FIG. 6), a plurality of barbs or protrusions 193 (see FIG. 8), and/or a roughened surface portion 194 (see FIG. 9) formed on its upper surface 364 or a portion thereof. Also, the spiral-shaped spring 362 may be used in conjunction with a via 126 that opens only to the upper surface 122 of the substrate 120 (see FIG. 8). Further, at least a portion of the spiral-shaped spring 362 may be permanently deflected upwardly to increase the deflection of the spiral-shaped spring 362 upon engagement with a conductive ball 41, thereby increasing the biasing forces exerted against the conductive ball 41 and enhancing electrical contact therewith. For a preformed spiral-shaped spring 362 having a permanent upward deflection, the

spiral-shaped spring 362 may be positioned directly over the upper surface 122 of the substrate 120 with no via subjacent thereto (see FIG. 9).

Please replace paragraph number **[0062]** with the following rewritten paragraph:

[0062] Referring again to FIGS. 14 and 15, a cavity 133 formed in the layer of resilient conductive material 130 separates and electrically isolates the rosette spring 462 (as well as the associated conductive trace 132) from the remainder of the layer of resilient conductive material 130. Further, to facilitate the removal of oxides and contaminants from the exterior surface of a conductive ball 41, the rosette spring 462 may include cantilevered pedals 464a-d having a plurality of grooves 191 and ridges 192 (see FIG. 6), a plurality of barbs or protrusions 193 (see FIG. 8), and/or a ~~portion of~~ roughened surface <u>portion</u> 194 (see FIG. 9) formed on their respective upper surfaces 465a-d, or a portion thereof.

Please replace paragraph number **[0064]** with the following rewritten paragraph:

[0064] Each of the upper and lower surfaces 522, 524 of the carrier substrate 520 includes a layer of resilient conductive material 530a, 530b, respectively, formed thereon. A plurality of conductive traces 532a are formed in the <u>layer of</u> resilient conductive material ~~layer~~ 530a on the substrate upper surface 522, and a plurality of conductive traces 532b are formed in the layer of resilient conductive material 530b on the substrate lower surface 524. At least some of the conductive traces 532a on the upper surface 522 of the substrate 520 terminate at spring-biased electrical contacts 560a. The spring-biased electrical contacts 560a on the upper surface 522 are arranged in one or more two-dimensional arrays corresponding to the pinout of the BGA package or packages 10a to be mounted thereon. Similarly, at least some of the conductive traces 532b on the lower surface 524 of the carrier substrate 520 terminate at spring-biased electrical contacts 560b. The spring-biased electrical contacts 560b on the lower surface 524 are arranged in one or more two-dimensional arrays corresponding to the pinout of the BGA package or packages 10b to be mounted thereon.

Please replace paragraph number **[0066]** with the following rewritten paragraph:

[0066] To electrically connect the BGA packages 10a, 10b to the carrier substrate 520 of the MCM 500, each of the conductive balls 41a, 41b on the BGA packages 10a, 10b, respectively, is engaged with a mating spring-biased electrical contact 560a, 560b disposed on the MCM carrier substrate 520. Clamping elements 90a, 90b - which are shown in FIG. 16 as stab-in-place clips 95<u>A, 95B</u> - secure the BGA packages 10a, 10b, respectively, against the carrier substrate 520 to bias the conductive balls 41a, 41b against their mating spring-biased electrical contact 560a, 560b. The spring-biased electrical contacts 560a, 560b, each of which exhibits a deflection as a result of engagement with a conductive ball 41a, 41b, exert a biasing force against their mating conductive ball 41a, 41b and form physical and electrical contact therewith. To facilitate the removal of oxides and contaminants from the exterior surface of a conductive ball 41a, 41b and to enhance electrical contact therewith, the spring-biased electrical contacts 560a, 560b may each include a plurality of grooves 191 and ridges 192 (see FIG. 6), a plurality of barbs or protrusions 193 (see FIG. 8), and/or a roughened surface portion 194 (see FIG. 9) formed on a surface or a portion of a surface thereof.

Please replace paragraph number **[0067]** with the following rewritten paragraph:

[0067] Although the spring-biased electrical contacts<u> or springs</u> 160, 162, 262, 362, 462, 560a, 560b according to the present invention have been described herein in the context of establishing electrical connections with the conductive balls 41 of a conventional BGA package 10, it should be understood by those of ordinary skill in the art that the present invention is not so limited. The spring-biased electrical contacts<u> or springs</u> 160, 162, 262, 362, 462, 560a, 560b may be used to electrically connect the leads of other types of IC packages to a substrate, such as the substrate 120 of substrate assembly 100 or the carrier substrate 520 of MCM 500. For example, any of the spring-biased electrical contacts<u> or springs</u> 160, 162, 262, 362, 462, 560a, 560b incorporating any of the features described herein may be used to electrically connect the lead elements or lead fingers of an SOJ package or the lead elements or lead fingers of a TSOP to a substrate. Also, those of ordinary skill in the art will appreciate that the various features described herein - i.e., preformed deflections, via 126 extending through substrate<u> 120</u>,

via 126 opening only to one surface of substrate 120, no subjacent via, and contact elements 191, 192, 193, 194, such as grooves, ridges, barbs, or roughened portions - may be incorporated in any suitable combination with any of the spring-biased electrical contacts or springs 160, 162, 262, 362, 462, 560a, 560b described herein.

Please replace paragraph number **[0068]** with the following rewritten paragraph:

[0068] The present invention also encompasses methods of manufacturing a substrate assembly 100, or MCM 500 - including substrates 120, 520 and spring-biased electrical contacts 160, 162, 262, 362, 462, 560a, 560b, as described above - according to the present invention. Referring to the flow chart of FIG. 17, from which the methods of the invention may be better understood, various embodiments of a sequence of acts or steps, generally denoted as 600, comprising various methods according to the present invention are shown. One embodiment of such a method begins with the act 610 of providing a substrate. The substrate may comprise an MCM carrier substrate, a burn-in board, or other test board, and the substrate may comprise any suitable material or combination of materials, including PCB materials, plastics, resins, composites, glasses, ceramics, and other oxide materials, as noted above. The substrate generally includes a first surface and an opposing, second surface.